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PUBLIC WORKS

CITY COUNTY STATE

NIAGARA FALLS POWER CO.'S TUNNEL

This tunnel, 32 feet wide, 32 feet high and 4,400 feet long, is being driven through limestone in the upper part and shale in the lower part of the cross section. The lining has a nominal thickness of 2 feet. It is concreted around an adjustable traveling steel form designed and fabricated by the Blaw-Knox Co. Shaft work was commenced in April, and headings in July, 1921. About 400 men are now employed, and the work is progressing in five headings.

APRIL 22, 1922

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Heavy Duty
Mixer
IF dependable, no-delay, never-quit mixer performance is the greatest profit factor you can put on the job—*as beyond question it is*—then the greatest value you can buy in a mixer is Koehring experienced engineering and Koehring heavy duty standards in design and construction—Koehring's downright refusal to compromise in any detail at your risk of time and profit losses.
KOEHRING CAPACITIES
Pavers: 7, 10, 14, 21, 32 cu. ft. capacities mixed concrete, steam and gasoline. Write for catalog P 14.
Construction Mixers: 10, 14, 21, 28 cu. ft. mixed concrete, steam and gasoline. Write for catalog C 14.
Dandie: A light staunch mixer for footings, culverts, foundations, etc. 4 and 7 cu. ft. mixed concrete, steam and gasoline. Power charging skip, low charging platform, batch hopper, light duty hoist. Write for catalog D 14
KOEHRING COMPANY
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HEAVY DUTY

VOL. 52 NO. 16

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PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 April 22, 1922 No. 16

North Avenue Viaduct, Milwaukee

Excavation for substructure. Arrangement and installation of contractor's equipment. Steel centers for arch spans. Concreting superstructure.

The North Avenue viaduct, Milwaukee, is a reinforced concrete structure 1,385 feet long with a side approach about 550 feet long. The viaduct has a 40-foot roadway and two 10-foot sidewalks. It is about 67 feet in maximum height and consists of a retained embankment, steel plate girder spans, and reinforced concrete girder spans and columns for the approaches to three main river spans, each span having two arch ribs from 155 to 166 feet in clear span and all supported on reinforced concrete footings built in open excavation on shore and in the river channel at a maximum depth of about 24 feet below normal water level.

The side approach has a roadway 23 feet wide and no sidewalks. Its construction was entirely of reinforced concrete. The total amount of excavation was about 14,000 cubic yards and the total amount of concrete for the structure was about 17,000 cubic yards. About 1,000 tons of reinforcement steel and 200 tons of structural steel were used in the structure. About 1,500,000 feet board measure of lumber were required for falsework and forms.

The new bridge replaces a four-span pin-connected steel truss, deck bridge with 17-foot roadway and 8-foot sidewalks that occupied the same alignment but with a lower grade. It was substantially level at an elevation of about 40 feet above normal water level.

The contract was awarded Feb. 10, 1920 to Klug & Smith Co., Milkaukee, Wis., for a price of $628,000 and with a time limit of 400 working days. On account of difficulty in securing the necessary materials, work was not actually commenced until July 12, 1920. The old bridge was closed to traffic August 13, pedestrians being diverted to a temporary pile trestle bridge, located about 200 feet upstream from the old bridge. The old trusses were shored up and traffic on them was maintained for some time while the old abutments were removed to permit operations to begin as early as possible on the excavation and the construction for the piers and abutments for the new spans.

*Description of river spans and approaches was published in PUBLIC WORKS for February 11.

After the piers and abutments had been constructed to the level of the spring line, the old pin-connected truss bridge was moved bodily about 7 feet upstream, in which position it was used to support the arch form trusses during erection and over which were carried all timbers, forms, reinforcing steel, etc. for the south arch ribs. It was then carefully match-marked, disassembled by a traveling hand derrick and, being the contractor's property and being in good condition, was stored for reassembling or for sale.

COFFERDAMS

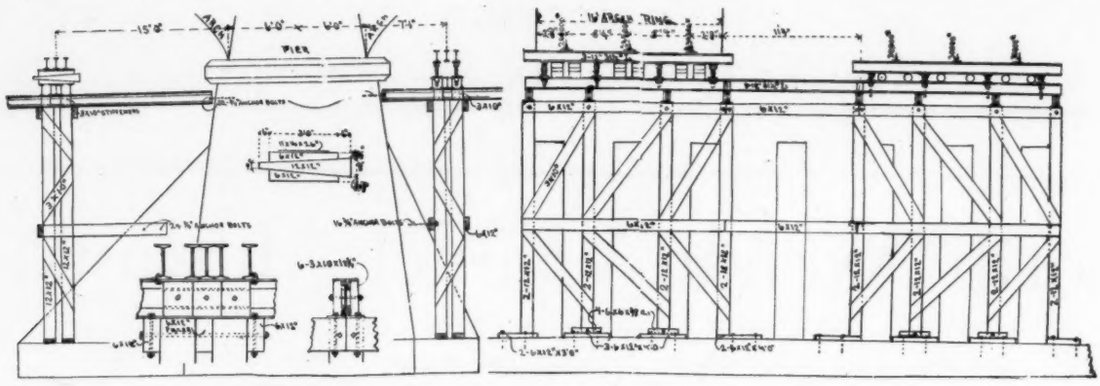
The contract provided for the lowering of water level by means of a control dam so that the substructure could be built more advantageously. Water was accordingly lowered about 10 feet, reducing the width of the channel to about 200 feet and the maximum depth of water at the site to about 6 feet, and thus permitting the 40x81-foot footings for the two channel piers to be constructed in the cofferdam excavation from 12 to 16 feet below the original surface of the river bottom. The excavations were made partly by hand and partly by a clamshell bucket operated by a derrick on the floor of the old bridge and partly by a steam shovel.

The 80x120-foot cofferdams were sheeted with 4x12-inch floor planks 18 feet long, removed from the old bridge and driven by a steam hammer. These cofferdams had no interior bracing, but the 12x12-inch waling pieces bearing against the tops and intermediate portions of the sheet piles were tied with cables to the old foundations.

The river bottom inside this cofferdam was excavated to a depth of about 4 feet on a natural slope and a new 44x85-foot cofferdam was built concentric with the old one. Besides being sheeted, it was lined as the excavation progressed with horizontal 2-inch planks bearing against outside rangers and against inside vertical 1½-inch round bars 4 feet apart, driven firmly into the river bottom and having their upper ends secured by wire ties to the sheet piles in the outer cofferdams. The excavation was then completed in the inner cofferdam. Pumps were provided between the inner and outer cofferdams to

pump from during the pier construction. After the concreting had been completed, the vertical 1½-inch rods were pulled out and used for reinforcements in the permanent structure.

sheave and thence around it and at right angles to the tracks to the second drum of the hoisting engine. At the river end of the first part of the hauling line and of the land end of the other part there were



FALSEWORK BENT SUPPORTING STEEL ARCH CENTERS.

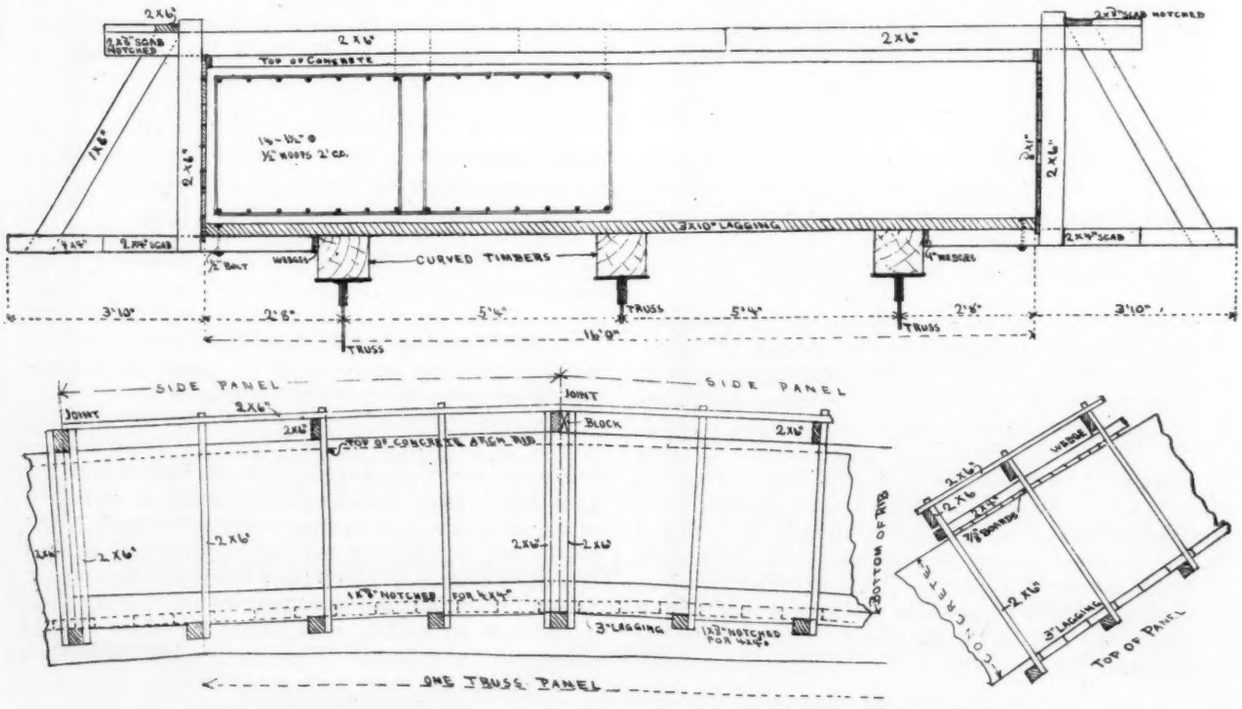
GENERAL INSTALLATIONS

The contractor's plant and office were located on the west bank of the river where concrete materials, reinforcements and other supplies were stored, shops established and a concrete mixing and distributing plant installed. Materials were delivered on a railroad siding 500 feet long, parallel and adjacent to the west end of the bridge, and cars were switched from this track to a parallel track by means of an endless hauling cable about 1,300 feet long, operated by two drums of a 40 horsepower stationary hoisting engine set near the river bank. One part of this hauling cable was led around a guide sheave and run 575 feet parallel to the two tracks, around two tail sheaves 21 feet apart, and back parallel with itself outside the second track, returning to a guide

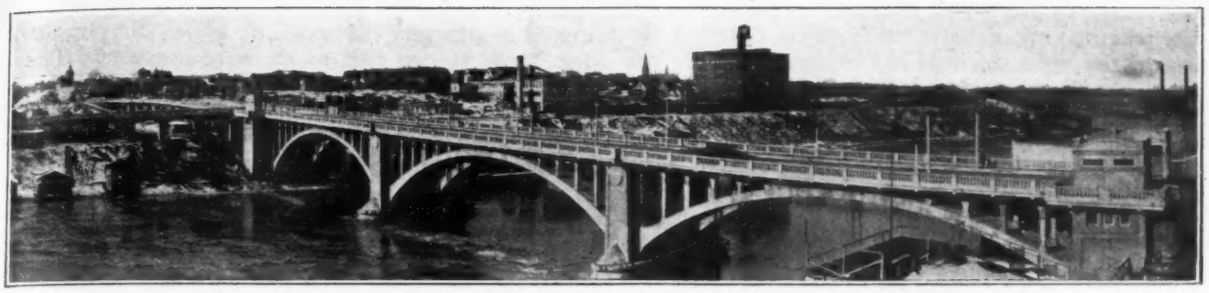
placed shackle attachments for snap chains by which the cars were hauled back and forth on the siding or the other tracks, thus spotting them wherever required for unloading ,and eliminating expensive services of a switch engine. The guide sheaves were set in steel frames anchored by four 20-inch vertical bolts to concrete pedestals 3 feet square and 4 feet deep.

SAND AND STONE SUPPLIES AND BINS

About 1,000 yards of sand and an equal amount of broken stone were maintained in storage in long narrow piles one on each side of the two service tracks. The materials were unloaded from railroad cars by a 1¼-yard Williams clamshell bucket suspended from the 90-foot steel boom of a derrick, operated by an American hoisting engine and com-



FORM FOR ARCH RIB; ALSO SHOWING ARRANGEMENT OF REINFORCEMENT.



RIVER ARCH SPANS AND VIADUCT APPROACHES.

manding the stock piles from which material was reclaimed as required to keep filled the elevated storage bins with a capacity for 200 yards of stone and 100 yards of sand. The derrick had stiff legs about 66 feet long and their center points were stiffened by inclined struts. They were securely anchored to concrete pedestals which served as counterweights. The mast and sills were supported on concrete pedestals about 10 feet above the surface of the ground. The pedestal under the mast was 3 feet square and had a 5x5-foot footing. The 24x24-foot engine platform was in the center between the sills and was supported from the ground by timber columns.

Sand and stone hoppers 20x24 feet in plan, and about 30 feet deep on the lower side and 10 feet deep on the upper side, were built on the slope of the bank with the inclined bottoms approximately parallel with the surface of the ground. The bins were lined with 2-inch vertical planks nailed to 6x12-inch horizontal girts, bearing on 6x12-inch vertical posts connected by five tiers of tension members, each having four 1-inch horizontal tie rods passing through the bin to resist the internal pressure. The bin was divided into two unequal compartments by an internal transverse partition made of planks nailed to one surface of 2x12-inch horizontal cross pieces. At the narrow bottom of the bins the walls converged to sectorial steel gates 8 inches high by 12 inches wide, that delivered into the measuring hoppers supported by vertical posts that carried a portion of load from the adjacent cement storehouse with a capacity of 6,000 bags.

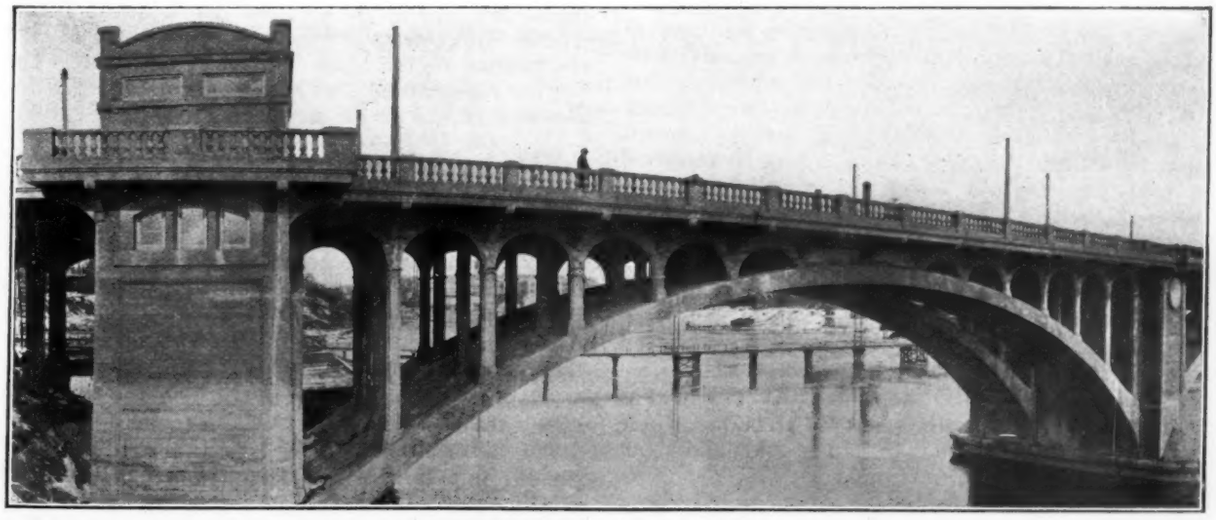
CONCRETE MIXING

The hopper in the bottom of the storehouse floor received cement as the bags were emptied into it and delivered it to a 10x10-inch vertical chute also terminating in a sectorial valve above the measuring hopper. The latter hopper delivered directly to the 1-yard steam driven Smith mixer that discharged its contents into the hoisting bucket at the foot of an Insley steel tower, 220 feet high.

Mixing water was delivered from a cylindrical tank filled to the proper quantity as indicated by a float gage, and discharged through a quick opening valve capable of delivering 35 gallons in 10 seconds. The discharge was a homemade device consisting of a 5-inch vertical pipe with a flange gasketted to a pine collar in the bottom of the tank. The upper edge o fthe collar was beveled, affording bearing for a 6-inch standard high-pressure copper ball, suspended from the long arm of a horizontal lever fulcrumed on the edge of the tank. A hand rod attached to the other end of the arm enabled the ball to be raised instantly and the contents of the tank immediately discharged to the mixer.

DISTRIBUTING CONCRETE

From the top of the tower, concrete was delivered both east and west through chutes suspended from cables attached to the tower on both sides. Concrete for the first of the channel spans and for the adjacent portions of the viaduct, was delivered directly by the chutes arranged and shifted as required and distributing the concrete up to distances of about



ABUTMENT PIER AND END SPAN.

325 feet maximum horizontally, thus covering the first of the main spans of the bridge. For the last two spans the concrete was spouted nearly 400 feet to a receiving hopper at the foot of an 80-foot steel tower and was then hoisted to the top of this tower and spouted to the shore end of the last span, serving the superstructure and the abutments there by means of a chute suspended from a cable attached to the top of the tower. For the construction of the center span the concrete was diverted from the main chute connecting the 220-foot tower with the auxiliary tower and was spouted through an auxiliary chute inclined toward the main tower and supported on a movable A-frame, shifted as required on the falsework for the spans. The 80-foot tower was situated on one of the river piers.

On the shore side of the main hoisting tower the chute was extended about 200 feet to a hopper mounted on the 35-foot mast of a derrick installed on the top of an 80-foot wooden tower and supplying a counterbalanced Insley system of chutes comprising one 50-foot boom section, two 50-foot sections supported on counterweighted cantilever trusses, and two 30-foot end sections that furnish a very flexible arrangement serving nearly 200 linear feet of the viaduct. The maximum distance that concrete was spouted from the 220-foot tower was 400 feet, and the total amount of concrete hoisted in this tower was about 16,000 yards. Besides the concrete handled by this system, about 1,000 yards, for remote parts of the viaduct and for footings and other purposes, was mixed in one half-yard portable Koehring machine and one 1-bag mixer. besides which there was provided a C. H. & E. mortar mixer at first intended for making concrete for the ballusters, which was not eventually used. The main mixing plant was served by an average force of six men including those required for unloading and handling the aggregate and for operating the tower hoists and chutes. The best record made was 350 yards of concrete mixed and placed in one 8-hour day and the greatest rate of mixing was 45 one-yard batches per hour.

The concrete for the arch ribs was placed simultaneously in making both sections, commencing at the skewbacks, each section being finished against a radial bulkhead, forming a construction joint separating one day's concreting from another. A maximum of 10 hours was required for concreting one section of the arch ribs. The centers were struck when the concrete was 30 days old, and no appreciable settlement occurred. There had been recorded a deflection of about 1 inch produced by the dead load of the concrete. This amount corresponded closely with what had been anticipated and prepared for by the super elevation of the centering.

The concreting of the spandrel columns and floor was continued as rapidly as convenient after the completion of the arch ribs and the work progressed continuously until the floor and sidewalk slabs were concreted, after which the balustrade railing was constructed in a separate operation. The balustrade was made with a base part cast in position and about 3,000 heavy round ornamental reinforced concrete balusters were precast in advance by a gang of four men working in a shop established under one of the approach spans. They were made of 1:3 hand mixed mortar at the rate of about 50 per day, for which 46 cast iron molds were provided. They were cast upside down to improve the exposed surface. The balusters were then placed on top of the railing base and the newels and top rails cast in position and an excellent result obtained.

(To be continued)

State Licensing of Engineers

In our issues of February 25th and March 4th we published an article giving a brief abstract of the requirements of the various states regarding the licensing of engineers. An engineer living in Idaho has written stating that we had apparently overlooked his state in the list. As a matter of fact not only Idaho but three other states—California, Illinois and Wyoming, have laws regulating engineering in some degree, but we followed the example of the American Association of Engineers in omitting these four states from the list because their laws were not as comprehensive as the others.

California has a law requiring that all county surveyors or candidates for that office be licensed surveyors.

Illinois has a law for the registration of structural engineers, this including those who design and supervise the construction or alteration of structures, such as those for electric power plants, water works, sewage disposal plants, bridges, etc. The fee for examination is $10 and for the certificate $5, with $1 for annual renewal.

Wyoming requires a certificate for those practicing surveying and engineering in respect to drainage, highway, municipal, county or state projects, the surveying of property lines or rights of way, or the preparation of applications for permits for use of water. The charge for examination is $10 and for certificate without examination $5.

The Idaho law provides for the registration of civil engineers, this including all branches of engineering except mining, metallurgical and military. Eramination is required for all applicants except those from other states, a non-resident practitioner being granted a certificate without examination if licensed or registered in another state whose requirements are equally as stringent as those of Idaho. These requirements are those for the degree of civil engineering of the State University of Idaho. The fee for registration is $10 for residents and $25 for non-residents, with $2 for annual renewals.

Use of Porous Sub-Base

In connection with other information concerning paving work in this city which was recently furnished us through the courtesy of John D. Seright, city engineer of Elwood, Ind., Mr. Seright makes the following observation: "I find no construction that holds up better under frost conditions and traffic than a base of coarse crushed stone. Even in concrete or bituminous bases it permits the water to escape readily, prevents capillarity and the consequent upheavals and cracks. I believe that four inches to six inches of this construction is well worth the additional cost in giving greater stability and arching over or spreading the load stresses to a firmer and drier sub-grade."

Wear Tests of Concrete

Bulletin 10 of the Structural Materials Research Laboratory, Lewis Institute, Chicago, contains 24 pages of diagrams, descriptions of tests and other data concerning the wear of concrete by Duff A. Abrams, Professor in charge of laboratory.

Although principal consideration is given to the result of wear tests, in nearly all instances parallel compression tests were made. The wear tests were made in the Talbot-Jones rattler run for 1,800 revolutions at the rate of 30 r.p.m. and charged with thirty 3¾-inch balls and 135 1⅞-inch balls, having a combined weight of about 200 pounds. The concrete blocks which formed the detachable lining of the drum were weighed before and after the test. The high-grade concrete showed a wear of about ½ inch and poor concrete lost as much as 2 inches.

The wearing qualities were considered to be affected by: Method of conducting the test, quantity of mixing water, quantity of cement, grading of aggregate, grading of coarse aggregate, comparison of different fine aggregates, comparison of different coarse aggregates, hydrated lime and other powdered admixtures, relation of compressive strength to wear, age of concrete, time of mixing concrete, curing condition of concrete.

This report contains brief résumés of these investigations. About 10,000 wear blocks have been tested, as well as several thousand compression cylinders and miscellaneous specimens. Tests were usually made at the age of 3 months after storing the blocks for 14 days in damp sand or moist air and the remainder in air at ordinary humidity.

The following are some of the conclusions based on the wear and compression tests of concrete covered by this report:

"The wear on separately molded concrete blocks tested in the Talbot-Jones rattler was much more severe than any encountered in service; however, the test is believed to give trustworthy information on the wearing resistance of concrete of various proportions, consistencies, curing conditions, ages, etc., for use in concrete roads and pavements. * * *

"In general the factors which gave concrete of high strength also gave concrete of low wear (a high *resistance to wear*).

"Increasing the quantity of cement reduced the wear.

"Increasing the quantity of mixing water, beyond the minimum required to produce a plastic concrete, caused a material increase in the wear.

"The coarser the grading of the aggregates, up to certain limits, the lower the wear.

"Curing concrete under favorable conditions exerted a marked influence in reducing wear.

"Wear was materially reduced by longer mixing of the concrete.

"Wear was reduced (resistance to wear increased) with the age of the concrete.

"The quality of the fine or coarse aggregate produced less effect on wear than is commonly supposed. The wearing resistance of concrete is determined largely by the *quality of concrete* rather than by the type of aggregate. Good concrete can be produced from aggregates which are generally considered inferior, if other factors are properly taken into account."

Reclaiming Land at Belle Isle

By W. K. Crosson

Earth from city excavations is dumped in water off shore and placed inside dike by hydraulic dredge.

Detroit will add two hundred acres to Belle Isle, the city's playground, within the next five years. A triangular dike has been constructed and when the space that it encloses is filled in, it will add 45 acres to one end of the island. This will make the site for the $500,000 James Scott memorial fountain, which is now in the course of construction. This reclaimed land is estimated to have a value of $20,000 an acre and will increase the size of the island to over 900 acres.

In order to carry on this work, the city engineers started a reclamation program, in connection with which there are some unique engineering features. For instance, the dumping dock, where earth is dumped into city scows to be towed to the island, is 200 feet long and 115 feet wide at the river's edge and is reinforced with 46 tons of steel, and has as a unique feature a flaring edge, which overhangs 14 feet and permits a scow to get half its width under the dock, which allows the trucks to dump the earth directly into the middle of the scows.

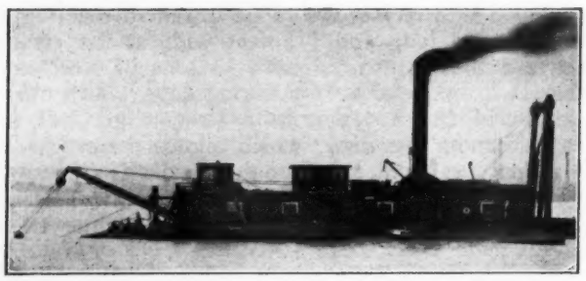
The earth is hauled to this dock from the different construction jobs throughout the city, the truck

DOCK WITH OVERHANG FOR DUMPING INTO SCOW.

owners paying the city $1.50 a load for the privilege of dumping. This revenue already is at the rate of $100,000 a year. The contractors are so glad to use the dock for disposing of excavated material that the city had to put two men on the dock as traffic officers to see that the trucks unload quickly and move off the dock, eliminating all tie-ups.

Three scows valued at $30,000 each with a capacity of 650 cubic yards or 130 truck loads, were purchased by the city in New York and towed to Detroit through the New York barge canal.

Tugs tow the loaded scows to a point opposite the dike, where a basin 17 feet deep, 200 feet wide and 700 feet long has been dredged in the bottom of the river. Here the scows dump the load through trap doors in their bottoms. A hydraulic dredge sucks up this earth and forces it through a 16-foot pipe to the area enclosed by the dike. By adding lengths of pipe the "soup" can be pumped to any spot within the dike. The dredge being used is valued at $175,000, but was purchased second hand by the city for $42,000 and renamed the "By Heck" in honor of Colonel Heckel, commissioner of parks and boulevards.



HYDRAULIC DREDGE AT BELLE ISLE.

The idea of dumping the earth into a submerged basin and then pumping it out again was declared impractical by some engineers. They declared that the pump would become clogged by the stone, bricks, refuse, etc., sucked up. This has proved unfounded as there has been no difficulty experienced from this source, and the method has proven entirely successful.

There are other advantages occurring from the new dump; for one thing, it saves the city's streets from the wear and tear which would result if all the scores of trucks dumping there now had to make the longer haul to the older dumps in the outskirts. Thus the traffic situation is greatly relieved. Also, to the contractor the privilege of dumping at the rate $1.50 a load means a big saving because of the shorter haul than to the other dumps.

Cleaning Catch Basins in Boston

On March 20th bids were opened by Joseph A. Rourke, commissioner of public works of Boston, Mass., for cleaning catch basins in seven districts, the contract prices being based upon the cubic yards removed as the unit. The amounts estimated to be removed varied from a maximum of 8,000 in each of two districts to a minimum of 1,200. In the two largest districts the contract was awarded to the C. & R. Construction Company at $1.59 per cubic yard. There was one bid lower than this, namely $1.40 for District No. 7, for which 6,300 cubic yards were estimated. The next highest bid was $1.62 for District No. 3, 3,200 cubic yards; followed by $1.78 for District No. 6 with 3,400, and $1.89 for each of the remaining two districts for which the estimates were 2,400 cubic yards and 1,200 cubic yards respectively.

Construction of Franklin Highway*

By E. H. Sauerman

Safety devices on industrial track, on which cars are hauled by tractor, Equipment used

SAFETY DEVICE

The cars were protected on the steep grades by automatic safety devices placed on the rear cars. This consisted of a 25-pound rail, 30 inches long with one end bent to an angle and pivoted to the coupling pin of the draw head. The other end dragging on the ground at an angle of about 40 degrees with the horizontal was split to a forklike shape and immediately dug deeply into the ground and held the train in position as soon as the tension was relaxed on the hauling line. This device was tested several times and always as soon as the tractor slacked off, or on another occasion when the tow line broke, it operated instantly to hold the cars fast, and after its adoption three or four miles of concrete was laid without any wrecks at all, thus eliminating what otherwise might have been a serious danger.

As soon as the switching engine of Pecan Siding delivered a train to the foot of the first grade, the 3-ton locomotive was detached and the four-car train was hauled up the grade by one of three 10-ton tractors which were kept always in service while two more, one at the bottom and one at the top of the long grade, were held in reserve. The tractors had abundant power to haul trains of more than four cars, but it was decided to limit the train lengths in order to avoid excessive stress on the tractors. When the tractors arrived at the top of the grade the full cars were attached to a locomotive waiting there and taken on to the mixer. In going down grade the tractor was attached in the same manner to the cars and idled along with the empty cars, which it delivered to the locomotive at the foot of the slope.

HAULING TRAINS

The cars were hauled up and down the slopes by tractors because the tractors were available from government supply, and because the lengths and steepness of the grades and the many curves in them would have made the use of a hoisting engine and cable very difficult and expensive. The trains were hauled up the 9,000-foot slope at the second speed of the tractor in about 20 or 25 minutes and descended rather more quickly at the first speed of the tractor. The system operated very satisfactorily and without any accidents or delays whatever.

*Continued from page 257.

Although the industrial track was laid with heavy grades, the 50 cars used on it for hauling concrete to the mixer were not equipped with brakes, because their inadequacy and the usual inefficiency of brakemen, together with uncertain and varying conditions have, on previous occasions, caused many wrecks. A simple scheme was therefore devised which provied an almost automatic and very efficient regulation of speed that was entirely reliable, inexpensive and simple, and prevented the occurrence of any accidents during the progress of the work.

The cars were hauled by the tractor in both directions to the top of the long grades between which the central station at Pecan siding was located. At the tops of these grades they were hauled by the gasoline locomotives over grades up to 6 per cent, where the locomotive brakes were entirely inadequate to handle the trains. The locomotives were therefore supplemented by retarding shoes placed on the forward ends of the trains or locomotives according to the direction in which they were operating. The brake shoe consisted of a steel cradle with two ⅜x 1½-inch flat bars, 18 inches long with the forward end curved 90 degrees over a 6-inch radius, about fitting the circumference of the wheel. These shoes were connected together by a pair of transverse drop bars offset downward to clear the wheel flanges and spaced to maintain the shoes to the track gage so that one shoe would slide on each rail with the curved end forward. At the beginning of a downgrade, the engine driver dropped the cradle on the track in front of the forward car and the front wheels, immediately riding onto the shoe, coasted down the incline without wear or injury, and reduced the speed of the train so that it could be easily handled by the locomotive while the train descended by gravity. On very light grades the shoes, of course, were not needed because they would entirely stop the train. The cradles were made by the blacksmith at a very small cost and were entirely successful in preventing all accidents due to grades. They were not, however, required or used on the steepest slopes, where the trains were moved up and down by tractor hauling and were controlled as before described by a trailing safety device, of which ten or a dozen were provided and always kept in readiness at the incline. By this system, an economy in brakemen was effected and the flattening of wheels by locking was eliminated.

CONCRETING

The gang working at and around the concrete machine averaged about twelve men and under favorable conditions laid up to 460 linear feet of pavement in a 10-hour day. The road forms, of the heavy type of the Heltzel Steel Form and Iron Co., were mounted on pedestals and gave excellent satisfaction. A force of three men were required for setting and adjusting them, moving them forward, cleaning and resetting them, and kept them at a minimum of about 1,000 feet in advance of the concrete mixer.

The concrete was mixed in an Austin cube paving machine at an average rate of about 250 batches per 10-hour day and at a maximum rate of 300 batches in one 10-hour day. The concrete was finished by a Lakewood machine, which was used throughout, including the long-radius curves. Expansion joints ½-inch thick were made of Carey roofing felt and placed at all points of curvature and points of tangency of both vertical and horizontal curves as well as at the end of the day's work. The forms were generally advanced in 200-foot lengths which were removed, oiled, cleaned and piled on the finished concrete until convenient to carry them forward on the batch box cars.

The finished concrete was protected with transverse strips of 72-inch burlap that was applied as soon as the surface was finished. It was kept wet for 24 hours and then removed and replaced by straw which was kept wet for about 14 days. No dirt whatever was used for protection.

The work was executed by an average force of about 110 men under the direction of W. E. German, superintendent; Mr. Mason, chief inspector, and Mr. Buckius, district engineer. Concreting was commenced in August, 1921, and will probably be finished by October, 1922, about 45 per cent of the work having been completed before it was suspended for the winter months. Common labor received about 35 cents and skilled labor up to 80 cents per hour, making an average payroll of about $7,000 per month.

The equipment used on the job included three Buffalo Springfield rollers, each provided with a scarifier; one 18-ton Erie shovel, seven 10-ton Holt tractors (two for excavation and five for concrete); one Austin cube mixer 21E with automatic water tank, boom and bucket, unloading derrick and caterpillar traction; one Lakewood sub-grader; fifty Koppel cars fitted with two five-bag batch boxes with separate cement container and cover; 3,000 lineal feet of the heavy type of Heltzel road forms mounted on pedestals; one Ohio locomotive crane, one 3-ton Whitcomb yard locomotive, five 7-ton Government Baldwin-Whitcomb hauling locomotives and one Ingersoll-Rand "Imperial" air compressor.

Refuse Collection in Washington

The report of the Engineer Department of the District of Columbia, for the year ending June 30, 1921, of which department Col. Charles W. Kutz is engineer commissioner, states that for that fiscal year the operations of the city refuse division were covered by two appropriations; one of $375,000 for dust prevention, cleaning of streets and alleys and snow removal and the second of $750,000 for the collection and disposal of refuse.

The department collected 60,058 tons of garbage, an amount greater than ever before collected, at a cost of $244,440. The revenue from grease and tankage produced from this garbage at the reduction plant was $155,197, while the cost of operating the plant was $196,163. The sum received from grease and tankage was smaller than during the two previous years because of the unprecedentedly low prices prevailing for such products. After April, 1921, the price offered for tankage did not equal the cost of production and the tankage cakes were simply piled up and not sold.

Because of the mild winter, the amount of ashes collected was only 133,940 cubic yards as compared with 148,228 cubic yards the previous year.

In 1920 the contractor for operating the salvage plant failed and this work was taken over by the

district until the termination of the contract on June 30, 1921. During the operation by the district the revenue from the salvaged material amounted to slightly more than the cost of operating the plant.

During the three years prior to the writing of the report, the district had taken over as municipal functions the collection and disposal of the three classes of refuse—garbage, ashes and trash. It therefore seemed necessary, in the opinion of Col. Kutz, that the department secure a stable in the suburbs, repair shop, garage for trucks; that the present garbage reduction plant be overhauled and remodeled and an up-to-date trash plant be constructed with an incinerator of large capacity located in the industrial section along the railroad; and also that the district obtain property outside of its limits for dumping purposes.

Washington Municipal Asphalt Plant

Amount of work done, cost of the various operations and unit cost of asphalt mixtures

The total output of the municipal asphalt plant of the District of Columbia for the year ending June 30, 1921, comprised 195,336 cubic feet of old material mixture, 3,624 cubic feet of asphaltic concrete mixture and 16,872 cubic feet of topping mixture. The plant was operated for 248 days with an average daily output of 870 cubic feet. The crusher was operated 76 days and crushed 4,302 cubic yards of old material hauled to the plant from various streets.

Pains were taken to keep both the plant and the crusher constantly in a good state of repair and the best possible operating condition. The cost of maintenance and repairs is included in the following cost of producing materials.

For operating the crusher and mixer there were used 28,612 gallons of fuel oil at an average cost of 10.1 cents per gallon, 196 tons of coal at an average cost of $9.25, and 76 cords of wood at an average cost of $19.80.

The operation of the crusher for 76 working days during the year totaled $6,549 for labor and fuel, or $1.52 per cubic yard. Maintenance, renewals and repairs cost $556 or 12.9 cents per cublic yard. For calculating overhead cost the original cost was amortized by reducing 20% each year during the first five years of its life. The total cost of material crushed averaged $1.649 per cubic yard.

The 248 days of operation of the asphalt plant involved an expenditure of $14,678 for labor, $2,986 for fuel oil, $1,651 for coal and $863 for wood; this giving a total cost of 9.34 cents per cublic foot for the asphaltic product. Hauling from the plant to the street cost 8.46 cents per cubic foot. On the street, labor cost 25 cents per cubic foot, pointing joints 0.45 cents per cubic foot and wood 0.30 cents per cubic foot; a total of 25.75 cents per cubic foot. Maintenance and repairs at the plant cost 0.89 cents per cubic foot and on the street 0.11 cents per cubic foot. Supervision cost 3.55 cents per cubic foot. This gives a total manufacturing cost of 48.10 cents per cubic foot.

Sand was bought under contract at 84 cents per cubic yard and hauled from the wharf to the plant at a cost of 37 cents per cubic yard.

COST OF MIXTURES.

From the above and combining the other items, the cost of a cubic foot of old material mixture was calculated as follows: 0.65 cubic foot of old material at $1.65 per cubic yard, 3.97 cents; 0.35 cubic foot of sand at $1.21 per cubic yard, $2.60 cents; 3.12 pounds of limestone dust at $4.40 per ton, 0.69 cents; 4.58 pounds of asphaltic cement at $24.61 per ton, 5.63 cents. This gives a total cost for material of 12.89 cents per cubic foot. Adding this to the manufacturing and placing cost of 48.10 cents, gives a total cost per cubic foot of 60.99 cents.

Asphaltic concrete mixture consisted of 0.5 cubic foot of screenings at $2.60 a ton, 0.5 cubic foot of sand, 4.2 pounds of limestone dust and 9.16 pounds of asphaltic cement, all at prices given above, giving a total cost for material of 22.52 cents. Adding this to the manufacturing and placing cost gives a total cost per cubic foot for new asphaltic concrete mixture of 70.62 cents per cubic foot.

Topping mixture cost 67.71 cents per cubic foot, consisting of one cubic foot of sand, 4.20 pounds of limestone dust, 9.16 pounds of asphaltic cement, giving a total cost for materials of 19.61 cents, to which is added the same manufacturing and placing cost as above.

PAVEMENTS NOT UNDER GUARANTEE.

The amount of asphalt streets not under guarantee by contractors totaled 3,253,588 yds. The total cost of minor repairs to these pavements during the year was $122,142, giving a cost per square yard for maintenance of 3.75 cents. Maintenance costs similarly calculated for former years, from the year 1908 to date, were as follows: 3.8 cents, 2.3 cents, 2.6 cents, 2.2 cents, 2.4 cents, 2.0 cents, 1.9 cents, 1.9 cents, 1.8 cents, 1.5 cents, 1.7 cents, 3.07 cents, 3.38 cents. "The marked reduction for the year 1917 is affected very significantly by the law effective that year by which repairs to pavements over one year old are chargeable to repair appropriations instead of being paid for by the paving contractors under a five-year guaranty as formerly. The yardage of pavement over which our repairs were distributed was thus increased by nearly 700,000 square yards, on which practically no expenditures were needed, as the pavements were only from one to five years old."

"In connection with these costs of annual repair it should be considered that some of the streets approximate an age of 40 years and that the average age of those we have resurfaced in recent past years exceeds 25 years. The average age of streets resurfaced in 1910 was 25.8 years; in 1911, was 24.5 years; in 1912, was 25.8 years; in 1913, was 26 years; in 1914, was 28.5 years; in 1915, was 28 years; in 1916, was 29.6 years; in 1917, was 27 years; in 1918, was 26 years; in 1919, was 26.7 years, in 1920, was 23.6 years; in 1921, was 23.2 years."

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Maintenance of Roads

A neglected road, like a neglected automobile or other piece of machinery, after a short time begins to deteriorate rapidly unless it is properly and continuously maintained. Most states have come to realize this already; some, however, not until they have seen some of their roads go entirely to pieces because of neglect.

As the mileage of paved roads multiplies, the cost of upkeep increases, while the cost of constructing new roads decreases, until maintenance cost exceeds construction cost. Many counties are appropriating for maintenance this year sums that would have seemed enormous for construction a few years ago. Oakland county, Michigan, spent $282,487 for maintenance last year and has $300,000 available for this year; while $200,000 is available by Montgomery county, Alabama, Sacramento county, California; Oswego county, New York; Hancock county, Ohio, and others.

In last week's issue of *Public Works* we gave the figures of last year's expenditures and this year's appropriations for maintenance by several hundred counties. This year's appropriation averaged $45,560 per county, and as these reports were obtained from counties in nearly all the states, this may be assumed to be the average for all the counties of the country. Some states will, of course, average higher, some lower. For example, 48 of the 99 counties of Iowa average $49,200 or an indicated total of nearly $5,000,000 for this state alone.

There are in the country 3,013 counties, and if we use the above average as applying to all of them, we have a total for the United States of $137,272,280 available for maintenance this year, and approximately that amount was spent for that purpose in 1921.

For maintenance, different states and counties use different appliances, as shown in one of the tables in last week's issue. In most cases the states have studied carefully the local needs and helped the counties to select the methods and appliances best suited to their own kinds of roads, soil, climate, local materials, finances, etc. Trucks, drags, scrapers, scarifiers, plows, rollers, asphalt kettles, are among the larger pieces of apparatus used; while probably all counties supply their maintenance forces with hand tools, wheelbarrows and the like. In fact, considering that maintenance covers the entire state while construction is in spots only, road maintenance probably requires a larger total equipment than does road construction.

Income From Refuse Disposal

An article elsewhere in this issue gives in abstract the opinions of an English and a Canadian in reference to the matter of disposing of municipal wastes, each referring to the income obtainable in connection therewith. One of these, speaking before a Canadian society, advocates the utilization of garbage for its fuel value, stating that the heat generated can be used for power production when at least 40 tons of garbage per 10 hours is available. The English engineer, however, considered incineration to be uneconomical because it is difficult to utilize efficiently the fluctuating amount of steam. This writer seems to prefer disposal by dumping, by crushing or by salvaging, but admits that the two latter depend for their success upon the availability of suitable markets for the crushed refuse used as a fertilizer or for the materials salvaged.

This matter of finding a market for by-products or salvaged material has not been given sufficient consideration in the past. Even with the comparatively small amounts of material now being salvaged and of grease and tankage being obtained by reduction of garbage, the market does not at present seem able to absorb all of the material, grease is being sold for a small percentage of that received for it when reduction plants were few, and tankage can find no market at all at present.

In all of these methods in which the return of a part of the cost of operation and of interest on construction is expected from the sale of products or by-products, the saving thus anticipated is ordinarily calculated to be a comparatively small amount—so small that a not very considerable change in market conditions may easily change the profit into a deficit. When an appliance or method introduced for the purpose of deriving a profit from refuse disposal forms any considerable feature of a project, such project becomes largely one of manufacturing and should be considered as such, and should be under-

taken only under conditions which a manufacturer would consider as warranting his investment in a plant of similar cost.

Engineers' Plans for State Health Boards*

For what kinds of work and under what conditions it is necessary to file plans for water works and sewerage systems in the several states

Alabama.—Petition for permission and complete plans and specifications and a general description of any proposed water supply system or changes in an existing system must be filed with the state board of health; not including, however, mere extensions of the distribution system. This procedure is not required if water is to be furnished solely for use on private property where there is no industrial camp, hotel or resort, or if less than 50 persons are to be supplied. The board must then investigate the suitability of the proposed supply. There is no similar law relative to sewerage, but cities rarely accept plans and specifications from engineers without their first having been examined by the state board.

Colorado.—There is no general statute that requires the submitting of reports or plans for sewerage and water works, but it is the custom of engineers to submit such plans to the state board of health.

Georgia.—Cities or private companies, before installing a sewerage or water works system, including water purification plant, or making any change in an existing water works system, must file plans and specifications with the state board of health.

Indiana.—There is not any legislation requiring submitting plans of either sewerage or water works systems, but municipalities are asked to consult the board on such plans for their own protection and advantage.

Minnesota.—Complete plans and specifications of any system of water supply, sewerage, or refuse disposal for public use, which affects or tends to affect public health, or material alterations or extensions, must be approved before being installed. The courts have held that contracts for such work are void unless the plans have been approved by the state board of health.

New York. The New York procedure is the most complicated in the country, in that the jurisdiction is divided between three departments. Plans for sewerage systems and sewage disposal plants must be approved by the Bureau of Sanitary Engineering of the Department of State Engineer and Surveyor, while permits for discharge of sewage into the waters of the state must be obtained from the Bureau of Sanitation of the State Department of Health. Plans for water supply systems must be approved by the Water Power Commission. Approval must be had not only for original construction but for modification or extension of municipal sewers and sewage disposal works; also for extending the water mains of a municipality outside of its own limits, or those of a water company outside of the limits of the original franchise. Approval also must be had of the acquisition or condemnation of an existing water works system or any part thereof.

North Carolina. The law requires any municipality or corporation intending to build water works or sewerage system to consult with the state board of health in regard to the best source of supply for water or place and best methods of sewage disposal; also that plans and specifications be approved by the state board of health before contract for construction can be entered into, which contract would be null and void without such approval.

North Dakota. Plans for a system of water supply, sewerage or refuse disposal for public use in the state, which affects or tends to affect public health, must be approved before the system is installed, altered or extended.

Ohio. Plans must be approved by the State Department of Health for proposed public water supplies, purification plants or changes or extensions of the same; or for public sewerage systems or sewage treatment plants or changes in the same, designed for incorporated municipalities or communities, county sewer districts or other lands in a county outside of incorporated municipalities, where either water supply or sewerage is to be used for the service of three or more dwellings or other buildings. The same also applies to plants for county, district or other public institutions, privately-owned institutions, colleges, clubs, factories and other public, quasi-public or privately-owned buildings and places used for assemblage or employment of persons.

Oklahoma. Plans must be filed and a written permit obtained from the State Board of Health before letting a contract for constructing or doing any construction work for supplying water for domestic purposes to the public by means of a water works, this, however, not applying to extensions of water mains. The same is required for a system of sanitary sewerage or sewage treatment or any extensions thereof.

Pennsylvania.—State laws prohibit the construction of a waterworks without a written permit of the commissioner of health, application for which must be accompanied by plans. For mere extensions of distribution system, plan must be filed after construction, before close of calendar year. Approval of plans for dams must be obtained from State Water Supply Commission, which passes on their structural stability. Plans for sewerage systems or sewage treatment works and extensions must be approved by the state department of health.

Rhode Island. Plans and permits for water systems are not required, the State Board of Health having no authority to compel any water works to follow its advice. It examines plans and offers advice when requested, which frequently happens. As to sewers, the law does not specifically require the approval of plans, but the Board of Purification of Waters can order discharge of sewage or operation of sewage treatment plants discontinued, and it is

*Continued from page 238.

therefore to the advantage of communities and engineers to have their plans approved beforehand. The sanitary engineer of the State Board of Health also acts as sanitary engineer for the Board of Purification of Waters in this connection.

South Dakota. The Department of Sanitary Engineering was established last November and at the time of sending us information had no regulations or legislation providing for the approval of plants. It was hoped, however, that such regulations and legislation would be adopted and put into force very soon. The board hopes that these will provide for submission and approval of complete plans for sewer systems and water supply works.

Tennessee. Plans must be approved by the State Board of Health for new or proposed water supply and sewerage systems or changes in existing works, before construction can be begun.

Texas. Plans of water supply and purification works and for sewerage and sewage treatment systems must be submitted.

Virginia. Maps, plans and specifications must be filed with state board of health, and permit be obtained from board, before supplying water for drinking or domestic purposes to the public, or before changing or enlarging system, except the distribution system.

Washington. Approval of the State Board of Health is required of plans for a new system or changes or extensions of an existing system or for the disposal of waste products, where such system is for the use of "more than 5 families or 50 persons;" also for a new water supply or change or extensions to an old supply for drinking or culinary purposes or for use in swimming pools, where such supply is "for any number of persons exceeding 10 families or a total of 50 persons." (Probably the sewerage requirements also should have named 10 families rather than 5.)

West Virginia. Plans must be approved by the State Health Commissioner for any system of drainage, sewerage or water supply before construction begins. This work is in charge of the division of sanitary engineering of the Department of Health.

Wisconsin. Approval of the State Board of Health must be had before commencing construction of plants for new water supplies or extensions or alterations in the source, pumping equipment, purification plant, storage or any other part of the system which may in any way affect the quality or quantity of water in existing water works. Also approval must be had of plans for sewerage systems or alterations to existing systems or sewage disposal plants which may materially affect the quantity and quality of the effluent; also for refuse disposal plants or material modifications of existing plants.

Wyoming. Petition for permission and plans for a water supply system for domestic use must be filed with state board of health. This applies to alterations and extensions, but does not apply if water is to be used by the party himself on property where there is no industrial camp, hotel or resort, or when it is to supply less than 50 service connections, unless a formal complaint is filed.

Petition and plans are required for constructing a system or works for discharging sewage into any stream or other water used or intended to be used for human consumption or for domestic purposes or which may discharge into such water, or for maintaining a sewer farm or sewage treatment works; or for extending or altering any such system or works.

Proposed Reservoir for Boston's Supply

Reservoir to serve the Metropolitan district to cover thirty-nine square miles and cost sixty million dollars, recommended by Engineer Goodnough

The chief engineer of the Joint Board of the State Department of Health and the Metropolitan Water and Sewerage Board, X. H. Goodnough, has recently submitted a report to this board, and the board has submitted it to the legislature, which would call for the construction of a reservoir 17 miles long and 4 miles in greatest width with a capacity of 400,000 million gallons and estimated to cost $60,000,000. This reservoir would supply the needs of the municipalities in the Metropolitan district and of others within a radius of ten miles of Boston. The reservoir would cover the sites of Enfield, Greenwich and Prescott and part of the populated area of Bana, the total area covered being about 39 square miles.

While no specific recommendation is made for immediately starting this project, it is calculated that the present supply will be exhausted by 1935 or at least by 1938. The engineers estimate that it will require twelve to fourteen years to complete the reservoir.

At the point selected for the dam, the boundary between Enfield and Ware, the bed rock is covered with a deep deposit of drift, which is porous and water bearing and cannot be made impervious to water. Consequently it will be necessary to carry construction through this material to bed rock. The plans propose a core wall of impervious material to bed rock, which at its deepest point is 145 feet below the present brook bed, the dam itself being made of earth. At the westerly end of the dam a spillway and discharge channel will be constructed in rock, the discharge channel emptying into the river through an outlet channel well below the dam.

A dike will be necessary in the valley of Beaver Brook to confine the waters of the reservoir. The same difficulty was experienced in locating a favorable site for this dike, since the material at the low point in the land immediately surrounding the reservoir is very porous. Consequently, a site was selected about a mile south of the divide and here also a water-tight core wall carried down to rock will be required.

Some of the features of the dam are as follows: The flow line will be 147 feet above the present surface of the river, or 253 feet above the bottom of the rock gorge. The width of the rock gorge at the flow line is 2,700 feet. The dam itself will rise 18

feet above the flow line and have a top width of 36 feet.

At the Beaver Brook dike the flow line will be 115 feet above the brook and the top of the dam 260 feet above the rock gorge, while the length of this dam at the flow line will be 2,150 feet. It also will rise 18 feet above the flow line and have a top width of 36 feet.

The upstream slopes of both dam and dike will be somewhat flatter than 1 to 3 and the downstream slopes somewhat flatter than 2.5.

The drainage area is 186 square miles, and the storage capacity of the proposed reservoir would seem to be disproportionately large were it not for the fact that the plan contemplates the storage in this reservoir not only of the water of the Swift river, but also that from large areas in the water sheds of the Ware and Millers rivers, together with a possible subsequent extension to the Deerfield river, and even other areas may be added if future necessities should demand.

The proposed reservoir would flood 15.9 miles of railroads and 106 miles of highways. It would contain a number of islands which are rocky and for the most part covered with forest at the present time. It would be necessary, in order to protect the purity of the water, to acquire all of these islands and also the land about the margin of the reservoir in order to prevent uses of the reservoir which might be objectionable. It will be necessary for about 2,000 persons to remove from the area acquired, in addition to which there are 14 mills, 38 stores, 6 churches, 13 houses, 2 public buildings, 14 railroad stations, freight houses, etc., 463 occupied houses and 30 vacant houses, 381 barns in use and 18 vacant and 61 camps and summer cottages.

The soil seems to be favorable to use as a reservoir. The greater part of it is sandy plains covered with brush and having a very thin surface layer of loam. Swamps containing peat are exceedingly rare, totaling less than 700 acres. The engineers do not advise removing the surface soil, but only the bushes and trees. It is suggested as possible that over large areas the surface soil itself can be largely reduced to ashes.

Chlorination and Water-Borne Disease

An article discussing the relation between bacillus welchii and water-borne diseases and an editorial on the same appeared in the January 28th issue of the Journal of the American Medical Association. The former was by Herbert B. Larner, health officer of Montclair, N. J. In this article Mr. Larner expresses the belief that great sanitary significance should be attached to the presence of B-welchii in public water supplies because (1) During the gastro-intestinal outbreaks in Montclair in 1918 and 1921 anaerobic bacteria similar to B-welchii were found in the public water supply and in clinical findings in the cases of sick persons in the 1921 outbreak, while no typhoid cases occurred; the water supply in each case being suspected as the cause of the wide-spread outbreak; and (2) intestinal disease outbreaks such as occurred in Cambridge, Mass., in 1920 are believed by prominent sanitarians "as due possibly to heavy infection of water with B-welchii."

(In this connection it might be noted that the 1918 outbreak in Montclair was confined to this and to possibly one or two other communities out of a large number which were served by water that was derived from the same source and treated in every way similarly up to the point where it entered the mains. This case was discussed in PUBLIC WORKS and other technical papers at the time.)

In discussing this, the editor of the Journal of the American Medical Association states that the evidence available at present is quite inadequate for a scientific decision as to whether the ordinary B-coli test for water contamination is sufficient. He states that the nature and classification of the anaerobic organisms in water, the spores of which are not killed by chlorine (the so-called "stormy fermenters") still remain to be determined; it has not been shown definitely that these anaerobes in water supplies are B-welchii, and it has not been shown conclusively that the B-welchii organisms in water supplies are the cause of gastro-intestinal disturbances.

Incineration of Garbage

In discussing this, R. R. Knight, in a recent paper before a Canadian society, stressed the desirability of utilizing the fuel value of garbage—about one-fourth of the calorific value of poor coal—to bring about its own destruction. An average of one-fifth ton of garbage per capita per annum can be expected from a large community, and 1 lb. of garbage can be considered capable of evaporating 1 lb. of water in addition to the three-fourths lb. contained in the garbage. The heat generated can be used for power production, but, for this purpose, at least 40 tons of garbage per ten hours should be available. Incineration of garbage without the use of added fuel is considered impracticable for cities of less than 15,000 people. There should be no nuisance from a well-managed incineration plant. An incinerator for a city of 20,000 people should cost approximately $30,000.

The same subject was discussed by James Gair before the Royal Sanitary Institute (England), in which he claimed that the destruction of refuse by fire is not considered economical because (1) 40% of the refuse is incombustible; (2) the method is unreliable and irregular as regards steam raising capacity, making difficult the problem of utilizing efficiently the fluctuating amount of steam; (3) it involves a heavy working cost; and (4) it involves a high initial outlay.

He stated that an analysis of house refuse, especially in London, showed the chief constituents to be practically uniform. As a fair and general average, the writer stated that in every 100 pounds of refuse the component parts in pounds are: coal, 0.35; coke, 0.15; bones and offal, 0.37; breeze and cinder, 25.55; rags, 0.40; paper, straw, fibrous material and vegetables, 13.15; ash, 47.00; dust and dirt, 9.75; bottles, 0.48; metals, including tins, 0.68; crockery, 1.72; glass, 0.37. He estimated that only 60% of the above is combustible; that two-thirds of the total bulk will pass through a 2-inch ring; and that the calorific value of refuse is about 20-25% of the value of good steam coal.

Mr. Gair stated further, in reference to other

methods of disposal, that disposal by dumping, if carried out under careful supervision would result in the filling in of low areas without insanitary nuisance.

Disposal by pulverizing or crushing to prepare the refuse for use as fertilizer depends for its success upon (1) preliminary sorting of material in insoluble form; and (2) availability of suitable markets.

Disposal by salvage consists of passing the refuse over mechanically operated screens; sorting the salable waste; burning unsalable waste to produce steam for driving the screens; washing the screened waste to obtain a low grade fuel of uniform quality; and disposing of the fine ash and dust as a fertilizer after grinding to a powder. The success of a salvage plant depends upon availability of a suitable market for the materials saved.

New Imhoff Tank

New patent taken out by Dr. Imhoff for securing odorless decomposition by continuously mixing fresh sewage with decomposing sludge

A new patent has been taken out in this country by Dr. Karl Imhoff, having been granted on December 6th, 1921 to Dr. Imhoff and Heinrich Blunk, both residents of Essen on the Ruhr. This tank is entirely different in action from the one known in this country as the Imhoff tank, although in one form it bears considerable structural resemblance to it.

In the specifications of the patent (which is No. 1,399,561), Dr. Imhoff says that "to a certain extent, and under certain conditions, it is possible to obtain in the so-called Imhoff tank (a combination of sedimentation and decomposition chambers) a fairly odorless and a fairly rapid decomposition. All attempts have been in vain, however, to attain this rapid and odorless decomposition in ordinary sludge containers of any kind, when charged with sludge in the usual manner."

"When sewage material such as putrescible sludge, which usually has a high moisture content, or municipal sewage, which is also included under the term sewage material, is allowed to remain for some time in a container, various kinds of decomposition are taking place. The two most important classes of decomposition which take place may be termed putrid decomposition, which is characterized by the evolution of hydrogen sulphide and other bad smelling gases, and odorless decomposition, in which practically only odorless gases (mainly marsh gas and carbon dioxide) are evolved."

Dr. Imhoff says that the difficulty in securing odorless decomposition in ordinary sudge containers is due to failure "to promote odorless decomposition, which begins to take place in deposited sludge in a certain time, to a sufficient extent by the addition of food in the form of fresh sludge. Another reason is that it has been neglected to permeate the fresh sludge sufficiently early with the exciters of odorless decomposition so as to prevent the occurrence of putrid decomposition.

"Both errors may be avoided when in a ripened decomposition chamber a continuous and intimate contact between fresh and decomposed sludge is secured." The aim of this patent of Dr. Imhoff is to secure this mixing of fresh and decomposed sludge, which process is applicable not only to ordinary sludge containers but will "accelerate decomposition in Imhoff tanks."

The patent suggests two types of apparatus for performing this intimate mixing. In one of them fresh sludge is drawn from a sedimentation tank and decomposed sludge from a digesting tank, the two being discharged simultaneously into and through a pipe, which in turn discharges them into the digesting tank. Part of the digested sludge is discharged from time to time onto sludge beds, while the displaced supernatent liquid in this tank passes out through an overflow into the sedimentation tank.

In the other type of apparatus the fresh sludge is pumped into an equalizing chamber, from which it is discharged as desired into a sludge digesting tank which is provided with an upper and lower chamber separated by inclined slabs and a "V"-shaped gas deflector as in the ordinary Imhoff tank. Other deflector plates are placed below the gas deflector with a view to concentrating the rising of the bubbles to a point where they can effect a rapid mixing of the incoming with the decomposed sludge. Also compressed air is forced in through a pipe in the bottom of the lower compartment, to agitate the sludge and assist in mixing the decomposed sludge in the bottom of the tank with the constantly incoming fresh sludge.

There are eleven claims in the patent, but all of them are process claims rather than apparatus claims, there being no apparatus claim whatever. As is customary in endeavoring to cover every phase of a process, these eleven claims are made to cover every possible combination of "bringing decomposing sludge into intimate contact with fresh sludge" either simultaneously or successively, or mixing decomposing sewage material with fresh sewage material, or decomposing sludge with fresh sewage material, or fresh sewage material with decomposing sewage material or fresh sewage material with decomposing sludge.

Without having thoroughly investigated the subject, it seems to us that the mixing of fresh and digested sludge in order to secure a better character of sludge from a sewage plant is by no means novel but has been employed to a greater or less extent by many operators of Imhoff tanks, and there naturally arises the question whether this simple process is subject to patenting. The application for this patent was filed April 19, 1913, or nearly nine years ago, and it is possible that prior to that date, no deliberate mixing of raw and of undigested sludge had been practiced in this country.

It might be well for engineers who have been operating sewage treatment plants for a number of years to give careful consideration to this point and consult some of their past records with a view to having data on this point available for legal purposes.

Recent Legal Decisions

ILLINOIS DEPARTMENT OF PUBLIC WORKS HAS OPTION TO TAKE LAND AUTHORIZED FOR ROADS

The Illinois Supreme Court holds, Department of Public Works and Buildings v. Caldwell, 133 N. E. 642, that in a proceeding by the department to acquire a right of way for a state-wide system of hard roads, under Illinois Laws 1917, p. 707, § 11, a judgment which provides that, upon payment of the compensation ordered, the department is "authorized to enter upon and take possession of and use for the right of way purposes" the tracts of land so taken, is not subject to the objection that this gives the state an option to take the land, and that it should be ordered to take the land, since the State has a right to abandon the location and to refuse to pay the damages ascertained.

PUBLICATION OF NOTICE FOR BIDS FOR PAVING CONTRACT HELD MANDATORY

The Washington Supreme Court holds, Wyant v. Independent Asphalt Paving Co., 203 Pac. 961, that the state statute, Rem. Code 1915, § 5755, providing that notice inviting bids on a local highway improvement "shall be published for at least two consecutive weeks previous to the date of letting, in one or more daily or weekly papers published and of general circulation in the county, and in such other manner as the board may see fit to direct," was not complied with by publications on January 25th and February 1st, when the bids were considered and the contract was awarded on February 7th, since two weeks had not elapsed between the date of the first publication and the date of letting the contract. The court holds the provision of the statute, so far as the publication of the notice for two weeks is concerned, is mandatory and injunctive relief would be granted against proceeding with the contract if sought with a fair degree of promptness. If the sufficiency of the publication was not challenged until after the completion of the improvement, owners objecting might be held estopped by delay.

ZONING PLAN FOR PAVING ASSESSMENT PRESUMED PROPER IN ABSENCE OF EVIDENCE TO CONTRARY

A city council, as a board of equalization, adopted the zone plan for the apportionment of assessments, so that all property in the district within the zone nearer to the paving was assessed a higher per cent. of the tax, and the zone next further removed a medium per cent. and so on, reducing the amount by zones until the property in the farthest zone was required to pay the least proportionate part. Where no evidence was introduced by complaining property owners, in proceedings to review an order of the council fixing paving assessments, which would show that the assessment was not in accordance with nor in excess of benefits, the Nebraska Supreme Court, Broghamer v. City of Chadron, 186 N. W. 362, presumed that the plan adopted was a proper one. The board of equalization was entitled to a fair opportunity while it was in session to avoid error and to meet objections to the propriety of the plan of apportionment of the tax and the necessity of the expenditure.

ADOPTION OF CITY STREET AS HIGHWAY BY STATE OR COUNTY HELD NOT TO RELIEVE CITY FROM KEEPING IT SAFE FOR TRAVEL

When the Legislature creates a municipal corporation and grants it power to open, grade and maintain public streets within its corporate limits, the West Virginia Supreme Court of Appeals holds, City of McMechen vs. Wheeling Traction Co., 110 S. E. 469, that such parts of a public highway as may be within such corporate limits as are adopted by said municipal corporation as one of the streets thereof become a public street of such city, and the primary obligation to maintain the same in a reasonably safe condition for travel is upon the municipal corporation, and not upon the county court of the county wherein such municipal corporation is situated. And where under the provisions of the state road law the county or state authorities adopt a city street, or any part thereof, as a part of one of the highways of the state or county, the city in which such street is is not relieved of the duty and obligation to maintain the same in a reasonably safe condition. The effect of each adoption of such a street by the state or county authorities as a part of a main state or county road is held to be simply to enable the state or county authorities to spend the state or county funds thereon to make it reasonably correspond in its condition with the highway or highways with which it connects at the corporate limits of the city.

CONSTRUCTION AND REPAIR OF ROADS A GOVERNMENTAL FUNCTION—NEGLIGENT DRIVING OF REPAIR TRUCK

The West Virginia Supreme Court of Appeals holds, Douglas vs. Rodue County Court, 110 S. E. 439, that the construction, maintenance and repair of public roads of a county by its county court are governmental functions; therefore such court is not liable for an injury inflicted upon a citizen by the negligence of its agent, servant or employee in the execution of such work, unless the act causing the injury was of such character as to impose liability under the provisions of a statute. The negligent driving of a motor truck owned by a county court and used in repairing roads does not make the road unsafe for travel or "out of repair" within the meaning of section 154, chapter 43, Code Supp. 1918, and the county court is not liable for the death of horseman thrown when his horse took fright at the truck.

COUNTY CANNOT PAY MORE THAN CONTRACT PRICE OF ROAD CONTRACT

The Commissioners' Court of a county in Texas entered into a road contract to be performed according to specifications for the sum of $15,000. The Circuit Court of Appeals hold, Gray County vs. Hamer, 277 Fed. 155, that, under article 3, section 53, of the state constitution, providing that the legislature shall have no power to authorize counties or municipal authorities to grant extra compensation to contractors after service has been rendered or a contract has been entered into and performed in whole or in part, where no more work has been done than that specified in the contract, the county cannot afterwards allow a further payment.

NEWS OF THE SOCIETIES

CALENDAR

Apr. 20—NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES. Meeting called by committee of organization at Hotel Commodore, New York. General secretary, W. S. Hays, Drexel Building, Philadelphia.

Apr. 25-28—BUILDING OFFICIALS' CONFERENCE. Annual meeting. Hotel Lincoln, Indianapolis, Ind.

Apr. 26-28—SOCIETY OF INDUSTRIAL ENGINEERS. National spring convention. Detroit, Mich.

Apr. 27-29—BUILDING OFFICIALS' CONFERENCE. April 27-28, Clevland, O.; April 28, Massillon, O.; April 30, Youngstown, O.

Apr. 29—DETROIT ENGINEERING SOCIETY. Hotel Cadillac, Detroit, Mich.

May 8-12—AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Atlanta, Georgia.

May 9-11—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. Atlantic City, N. J.

May 12 — NATIONAL HIGHWAY TRAFFIC ASSOCIATION. Annual meeting. Automobile Club of America, New York City.

May 15-19 — AMERICAN WATER WORKS ASSOCIATION. 42d annual convention. Bellevue-Stratford Hotel, Philadelphia. Secretary, J. M. Diven, 153 W. 71st St., New York.

May 15-19 — NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention. Atlantic City, N. J.

May 16-18 — CHAMBER OF COMMERCE OF U. S. A. 10th annual meeting. Washington, D. C.

May 22-25—STATE PARK SECOND NATIONAL CONFERENCE, Bear Mountain Inn, Palisades Interstate Park, N. Y. Secretary Edgar E. Harlan, Des Moines, Iowa.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th annual convention. Salt Lake City, Utah.

June 7 — NORTHWEST SECTION, NATIONAL ELECTRIC LIGHT AND POWER ASSOCIATION. Boise, Ida.

June 13-16 — CANADIAN GOOD ROADS ASSOCIATION. Annual convention. Victoria, B. C.

June 19-22—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Summer meeting. Clifton Hotel, Niagara Falls.

June 21-22—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Portsmouth, N. H.

June 26-30—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual convention. Niagara Falls, Ont.

June 26-July 1 — AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Hadden Hall Hotel, Atlantic City, N. J.

Aug. 28-Sept. 2—NATIONAL SAFETY CONGRESS. Detroit, Mich.

Sept. 11-15—ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. New Auditorium, Cleveland, Ohio.

Sept. 25-28—SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 9-13—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Clevland, Ohio.

Oct. 16-19 — AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. Cleveland, Ohio.

Nov. 15-16—NATIONAL INDUSTRIAL LEAGUE. Annual meeting. New York City. Secretary, J. H. Beek, Chicago.

NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES CONFERENCE

This conference, held in Chicago, April 3, 4 and 5, was attended by a large number of realtors, bankers, insurance men, architects, engineers, builders, contractors, sub-contractors, materials and equipment producers and distributors, publishers and others from all parts of the country.

Discussions, intended to secure complete presentation of the subjects from every standpoint, were led by men of national prominence, and included the following principal topics: I—How trade associations can be made more effective; II—(Tuesday, April 4th)—Capital must be economically mobilized for construction and home building. How to provide capital for construction in periods of depression. III—Efficient workers needed to meet country's enormous construction program. Co-operation between employers, employees and educational authorities must develop sound apprenticeship systems and trade schools for building trades. IV—Handicaps to be overcome in reducing cost of construction. V—Can homes be built which workers can afford to live in? VI—Proper development of municipal building, highway, fire prevention and other inspection bureaus. VII—Progress industry has made in design, distribution, production, research, standardization, transportation and utilization of materials, and elimination of waste an inspiration to greater effort. VIII—What must the industry do to relieve the housing shortage? IX—The present situation in the agricultural industry. X—Community Construction Conferences. XI—Can construction be made less seasonal? XII—Promotion of greatest development of the combined industry.

Besides the regular sessions and time devoted to the inspection of exhibits there were several special luncheons and dinners, and a construction Gridiron Club Affair Tuesday evening April 4, all at the Drake Hotel.

A special luncheon meeting Wednesday noon, April 5, was held of Secretary Hoover's Committee on Construction Development with the officers of the leading national associations.

The sessions concluded with a dinner at the Congress Hotel, April 5. This construction industries dinner was the occasion also of a dinner for the Fourth American Lumber Congress, which opened on that day.

ROCHESTER ENGINEERING SOCIETY

At the special meeting, March 31, "Pioneer Inventions and Pioneer Patents" were discussed by Frank Keiper, patent attorney, who talked on widely used inventions that are known to everyone and the patents and claims on these inventions. His list included the Howe sewing machine patent, Morse telegraph patent, Goodyear's patent on vulcanizing rubber, Tilghmans patent on separating fats into fatty acid and glycerine, Bell's telephone patent, Edison's patents on the incandeseent lamp and talking machine, etc. He referred to earlier great inventions that preceded the U. S. Patent System, and showed from these how the invention must be described and claimed, how mistakes are made in the taking out of patents, and the effect of them and the remedy. He discussed the history and litigation of these patents and brought out many of the fundamental principles of patent law in connection therewith.

BROOKLYN ENGINEERS' CLUB

The informal library meeting was addressed March 30 on "Helicopters and Soaring Flight Without Motors" by Augustus Post, of the Aero Club of America. Mr. Post discussed the recent developments in helicopters which are now considered by many as a possible means of flight. He also discussed the very remarkable flights without motors recently made, and showed how the varying currents of air were used by the aviators.

NEW YORK SECTION AMERICAN SOCIETY OF CIVIL ENGINEERS

At the regular and joint meeting, April 14, the topic was: "Muscle Shoals as a Power and Nitrates Producer."

The subject of Muscle Shoals as a Power Producer was introduced by Brig.-Gen. Harry Taylor, Assistant Chief of Engineers, U. S. A.; Muscle Shoals as a Nitrates Producer was discussed by W. S. Landis, Chief Technologist, American Cyanamid Company, in its commercial aspect, and by Maj.-Gen. C. C. Williams, Chief of Ordnance, U. S. A., in its munitions aspect. Discussion was opened by Messrs. E. A. Yates, of Wood, Hulse and Yates Company, Engineers, and Francis E. Frothingham, of Coffin and Burr, Bankers. Motion pictures of the Muscle Shoals development were shown and explained by Mr. Theodore Nagel, Consulting Engineer.

The subject of the second Sub-Section group conference was "Structural Design and Details—the Responsibility of the Engineer." James E. Edwards, Assistant Chief Engineer of the American Bridge Company, presided.

SPRING MEETING AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Fine technical sessions and social events at Atlanta, May 8-11, preceded by visit to University of Virginia, May 5-6, and followed by inspection of textile plants at Greenville, S. C., May 12, of steel mills and foundries at Birmingham, May 12, and a visit to Muscle Shoals on May 13.

The mornings will be given over to the technical sessions, which will start at 9:30 a. m.

The Textile Division and the Machine Shop Practice Division have co-operated in two sessions, which will deal with textile machinery. The Materials Handling Division is presenting a paper on Material-Handling Equipment as Used in the Iron and Steel Industry. The Session on Fuels covers a wide range. The Manage-

ment Division will present two general papers which will open the discussion of management methods. The Session of the Power Division will be devoted to a consideration of hydroelectric power with special relation to some of the very important installations in the Southeast.

One of the most important sessions at the meeting will be that on Welding, which has been organized jointly by the Boiler Code Committee of the A. S. M. E. and the American Welding Society. The four papers for this Session on Welding are the first presentations of test data on the strength limits of pressure containers. The Muscle Shoals development in its relation to the nitrogen supply of the country is a matter that is attracting widespread attention at the present moment. The author of the paper on this subject was at one time Commanding Officer of the Nitrate Plant at Muscle Shoals and his statement of the facts will be awaited with keen interest.

The meetings in Atlanta will be held in the rooms of the Chamber of Commerce and the hotels which are centrally located. The Piedmont Hotel has been designated as headquarters and there will be found the registration bureau and the meeting rooms of the Council and committees. Simultaneous sessions will, however, require the use of other meeting rooms. The Atlanta meeting will be operated on the pay-as-you-go basis. The burden of the meeting is to be borne by the Society and by the members attending. In accord with this principle, and following the custom originated at the last Annual Meeting, a registration fee of $2.00 will be charged to members and their male guests. Ladies will be registered free.

At the Business Meeting of the Society, to be held on Monday afternoon, the proposed new Constitution of the Society will be presented for a first reading. It is an epoch-making document, for it is probably the simplest and most direct of any constitution of any engineering organization in the world. Other important items of business include the report of the Committee on Code of Ethics which has taken two years to prepare, and which has expanded to become a joint activity of several national societies.

SECTIONAL MEETINGS OF AMERICAN SOCIETY OF MECHANICAL ENGINEERS

An all-day hydroelectric conference was held in Philadelphia on March 21. The co-operating bodies were the Engineers' Club and the Philadelphia Sections of the A. S. C. E., the A. I. E. E. and the A. S. M. E. The Power Division of the A. S. M. E. assisted in the preparation of the program. Frank H. Rogers presented a paper on the 55,000 hp. turbines for the Queenstown-Chippawa development. He was followed by Charles M. Allen, whose paper was entitled Salt Velocity Method of Measuring Water in Pipe Lines. The third paper, entitled The Correlation of Momentum and Energy Changes in Steady Flow with Varying Velocity and the Application of the Former to Problems of Unsteady Flow or Surges in Open Channels was presented by Raymond D. Johnson. The final paper of the afternoon was prepared jointly by H. Birchard Taylor and Lewis F. Moody.

At the second technical session the Queenstown-Chippawa power development, was treated from three separate points of view. H. G. Acres, chief hydraulic engineer of the Hydroelectric Power Commission of Ontario, spoke on the General Description of Structures and Construction Problems; Edgar R. J. Brandon, electrical engineer of the Commission, treated the electrical features and the general features of design were given by T. H. Hogg, assistant hydraulic engineer of the Commission.

The seventh joint meeting of the Associated Technical Societies of Detroit was held under the auspices of the Detroit Section, A. S. M. E., on Friday evening, March 17, at the Detroit Board of Commerce. The speaker of the evening was John L. Harper. who gave an interesting illustrated talk on Niagara Falls Power Development.

ASSOCIATED TECHNICAL SOCIETIES OF DETROIT

The founding of the Associated Technical Societies of Detroit in January, 1922, was the culmination of a movement begun in earnest six months previously for the affiliation of the architectural, engineering and other technical societies of Detroit. The following twelve societies formed the charter membership: Detroit Section, American Society of Civil Engineers; Detroit Chapter, American Association of Engineers; Michigan Chapter, American Society of Heating and Ventilating Engineers; Detroit Post, Society of American Military Engineers; Detroit Section, American Society of Mechanical Engineers; Detroit-Ann Arbor Section, American Institute of Electrical Engineers; American Institute of Chemical Engineers; Detroit Engineering Society; American Chemical Society and Detroit Chemists; Michigan Chapter, American Institute of Architects; Detroit Section, Michigan Society of Architects and Detroit Chapter, American Society for Steel Treating.

The officers elected for 1922 are: chairman, P. W. Keating; vice-chairman, A. A. Meyer, and secretary-treasurer, Walter R. Meier. The society will take an active interest in all matters wherein engineering, architectural and technical subjects are an important factor and will assist in furnishing definite and accurate information on contemplated public improvements or undertakings by the city of Detroit or the State of Michigan.

A joint meeting will be held once a month; and as the new association will schedule the meetings of all the technical societies, conflict of dates with member societies will not occur. Also a central office will be established for conducting the business of the several societies and the combined interests of the professional men of Detroit will be represented by this organization.

PERSONALS

Brennan, B. C., for the past eleven years city engineer of Kenosha, Wis., has retired to enter the contracting field.

Silcox, Harold, Elizabeth, N. J., has been appointed general supervisor of bridges and structures in the construction division of the state highway division.

Reid, John W., has been appointed city engineer of Detroit, Mich., after 22 years' service with the Detroit department of public works, and Joseph L. Barton has succeeded to Mr. Reid's position of grade separation engineer.

Spear, R. E., city engineer and assistant city manager of Ambridge, Pa., has resigned.

Harrington, D. E., assistant city engineer of Madison Wis., has resigned to enter the engineering and contracting business.

Barrow, R. W., has been chosen building inspector of Meriden, Conn., a position recently instituted.

Brush, F. C., of Westfield, N. J., has been appointed city engineer of Norwich, N. Y.

Jones, Paul S., has been appointed superintendent of Imperial Mutual Water Co. No. 1, in Imperial Valley, Cal.

Tucker, M. P., has been appointed superintendent of waterworks of Akron, Ohio.

Hart, Samuel, has been appointed deputy city engineer of Sacramento, Cal.

Barber, Walter, formerly city purchasing agent for Long Beach, Cal., has been appointed assistant city manager.

H. P. NAWN

Henry P. Nawn, president of the Hugh Nawn Contracting Company, Boston, Mass., died March 28th at Gilboa, N. Y., where his firm is constructing the new $6,000,000 "Gilboa Dam," for the City Board of Water Supply, New York City. Mr. Nawn, who was sixty-six years of age, has performed several prominent public works, among them being the subway at Cambridge, Mass., and the Boston Elevated Railway structure in Boston.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

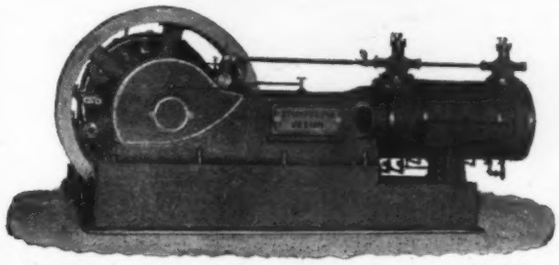
SUMMIT STREET SWEEPING MACHINES.

Following long observation, experiments, improvements and regular work in the streets of Akron, the new vacuum sweeping machines manufactured and sold by the Summit Street Sweeping Machine Co., have been perfected from the designs and patents of 1916 and are now under commercial production.

They eliminate dust by the vacuum system and do not require any sprinkling device. They clean the street from curb to curb with a large broom and a gutter broom, self adjusting to depressions and irregularities of the surface. All moving parts are positive or gear driven, and there are no annoying loose chains. The elevator will not clog and tear and the vacuum cannot become choked because the heavier refuse is handled by an elevator and the lighter part handled by the vacuum.

Considerable economy is due to the fact that the rear broom has been in constant operation on one of the machines for six weeks with very little sign of wear under service where other makes of brooms have to be changed every few days.

The machine has a capacity of 3 yards, is operated by a 60-h. p. motor, has Timken roller bearings throughout, double internal expanding service brakes on rear wheels, a rear broom 20 inches in diameter and 66 inches long, and an auxiliary or gutter broom 42 inches in diameter. Both brooms, the fan and the conveyer, are driven independently of the driving mechanism of the truck.



TYPICAL STUMPF UNA-FLOW STEAM ENGINE, HORIZONTAL TYPE.

UNA-FLOW ENGINE

This engine, manufactured by the Stumpf Una-Flow Engine Co., takes steam through the cylinder in one direction only, following the piston and exhausting through ports at the far end of the stroke in contrast with the ordinary counter flow engine where the steam enters at the end of the cylinder and follows the piston during the working stroke returning with the piston exhaust at the same cylinder end, and causing great loss of steam and much cylinder condensation.

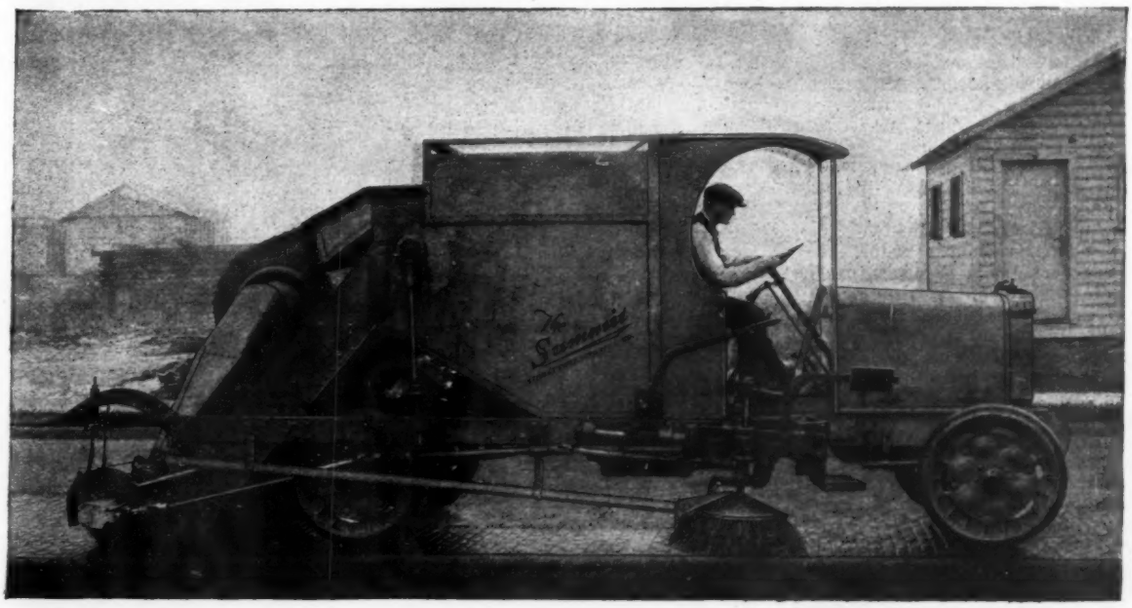
The Una-Flow system avoids cylinder condensation and has a cylinder head jacketed with live steam.

The Una-Flow engines claim marked superiority over other types in freedom of cylinder scoring or lubrication trouble even when highly superheated in its use. Economy is promoted by the smallness of leakage losses which are a minimum from cylinder condensation, volume of clearance, throttling, friction, leakage of valves and pistons, heat radiation and condensation, and incomplete expansion. The superiority of these engines is most noticeable when using high pressure or slightly superheated steam, when condensing with good or moderate vacuum, and when running with variable loads with heavy overloads for short periods and long periods of light or idling loads.

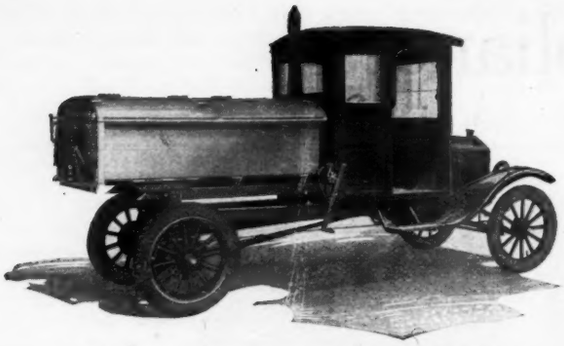
MARTIN-PARRY GARBAGE DUMP BODY.

This new Martin-Parry Garbage Dump Body No. 291 for Ford Truck users is similar in construction to the standard Martin-Parry Dump Body. It has a capacity of 40 cubic feet with dimensions of 72 x 44 and height of 20 inches. The body weighs 640 pounds. The inside is perfectly smooth without a bolt or nut to obstruct materials, and entire body is made of 10-gauge steel.

The body is now equipped to take extra side boards, and the garbage dump body has end gate gasket to make the body absolutely water tight. The covers are hinged and lock in place to secure



60-H. P. SUMMIT STREET SWEEPER MACHINE WITH ELEVATOR AND VACUUM.



MARTIN-PARRY STEEL DUMP BODY.

the garbage and to prevent the escape of odor. The body is equipped with a hand operated hoist, which will raise it to an angle of 47 degrees, and the body can be dumped in twenty seconds.

The hoist is fool proof, back geared three-to-one and operates through a BB chain running over a cast steel sheave gear. The double acting tail gate can be swung from top or bottom.

This body can be secured for $222.25 from any of the Martin-Parry Plants, which are located in all the larger cities east of the Mississippi River.

CATERPILLARS FOR RAILROAD-TYPE SHOVELS

The Bucyrus Co. is prepared to equip all sizes of railroad-type shovels with caterpillar traction.

This announcement, because of the economies of operation thus made possible, should prove of particular interest to all present users of railroad-type shovels as well as to prospective purchasers.

The principal advantages of mounting a shovel of this type on caterpillars may be summarized as follows:

No time lost in moving up.

An ordinary move requires about 10 seconds only.

No rails to lay.

No jacks to release and set.

No stops during operation to reset jacks.

The shovel is always ready to dig.

The shovel does not have to face blasting.

May be moved back out of the way quickly and easily.

Can be turned around quickly.

No track trouble when in water.

In emergencies, such as slides, can be moved back quickly out of danger.

Shovel can always dig at most effective distance from bank; short moves easy and quick to make.

No delay on account of boulders rolling in close to shovel.

Lighter work for pitmen.

Saves from 2 to 4 pitmen and sometimes more.

Can travel and work on approximately same character of ground as shovel on railroad trucks.

Where shovel on railroad trucks requires blocking under jacks and both rails, when working on soft ground, the shovel on caterpillars requires blocking only under the caterpillars.

This mounting consists in general of two forward caterpillars, replacing the jack arm, and two rear caterpillars mounted under the rear end of the shovel.

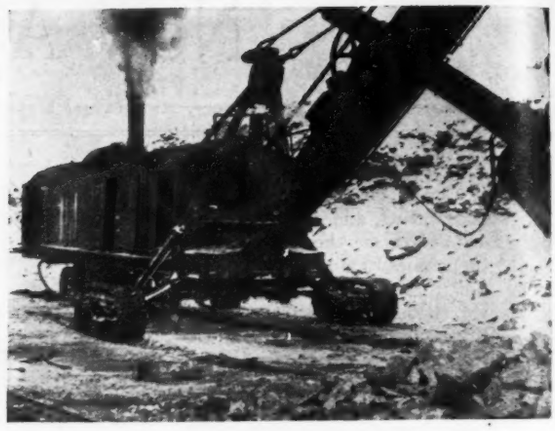
The front caterpillars are both drivers and are so designed that they can swivel and adjust themselves to unevenness of the ground. The rear caterpillars consist of two units mounted on the same frame. They are designed with sufficient strength to permit the crossing of holes and ditches without the delay incidental to filling in.

Steering is accomplished through the rear caterpillars. The massive steering arm is integral with the pintle of the rear caterpillar trucks. It carries a heavy gear segment which engages a pinion on a vertical shaft. It is driven by an independent center valve, reverse type engine, suspended underneath the car frame. This engine may be operated either from the operator's stand or from ground alongside the rear caterpillars. Steering in curves of large diameter can be accomplished by the swinging of the boom without the steering mechanism.

Propelling is accomplished through the front caterpillars, both of which may be driven together or each one independently, forward or backward, at speed of about half a mile per hour. The shovel can climb with ease 15 to 20 per cent. grades.

For transportation by rail, railroad trucks may be easily substituted.

The Bucyrus Co. was the first manufacturer to equip dragline excavators and revolving shovels with caterpillars. Well over one hundred caterpillar-mounted Bucyrus machines, weighing from 65 to 220 tons, have been sold within the past eight years and are successfully operating.

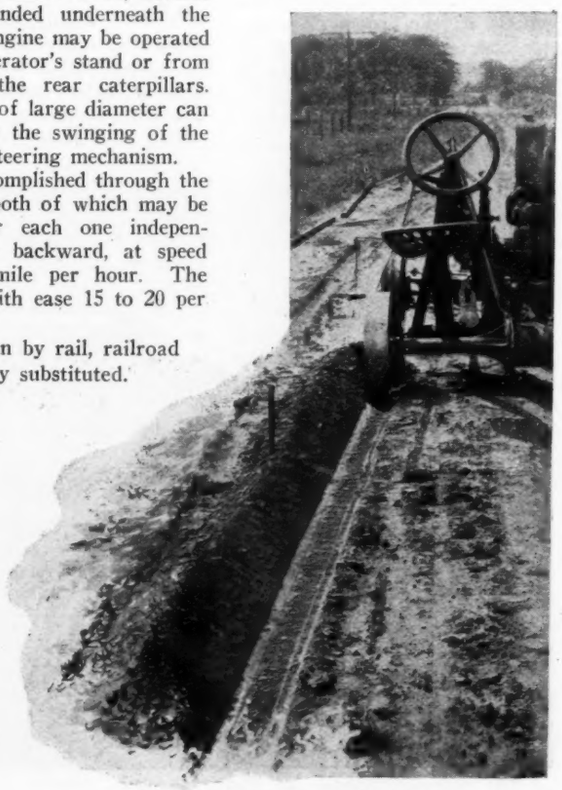


BUCYRUS RAILROAD TYPE STEAM SHOVEL EQUIPPED WITH CATERPILLAR TRACTION.

THE CARR FORMGRADER

This appliance, manufactured by Edward G. Carr, is a locomotive machine, provided with a cutter drive held against the blade line by a hair spring and kept in exactly the proper position by a hand wheel turned by the operator so as always to insure the proper depth of cut. The cutter knives only 2-inches wide are progressively set to cut a trench 8 inches wide through the shoulder earth.

The formgrader works from its own power, cutting 300 to 700 feet per hour under ordinary conditions, has a reverse gear and traveling speed of 4,000 feet per hour for moving from job to job, and can easily be run on a truck under its own power without dismantling.



THE CARR FORMGRADER.